Small Business Innovation Research/Small Business Tech Transfer

Environmental Mapping Payload Module for Astrobee, Phase I

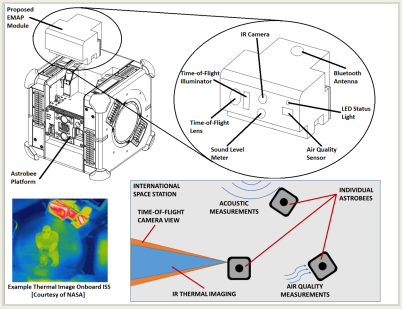
Completed Technology Project (2018 - 2019)

Project Introduction

The Environmental Mapping Autonomous free-flyer Payload (EMAP) Module is proposed to enable on-demand mapping of intravehicular environmental conditions by the Astrobee platform on the International Space Station (ISS). The proposed solution is an integrated multi-sensor module that enables collection and 3D visualization of environmental data, and robot-robot communication. This payload module builds on the utility of the existing Astrobee platform technologies. The EMAP Module is an operational subsystem of an Astrobee that facilitates data collection and reduces crewmember responsibilities. The envisioned environmental parameters to be monitored by the module are acoustic noise, air quality, and 3D thermal imaging. NK Labs will engage NASA and Astrobee developers to confirm this selection of sensors to best meet the ISS's environmental monitoring needs and expected future uses of Autonomous Free Flyers (AFF). Integrating a dedicated Time-of-Flight (TOF) camera will enable detailed 3D rendering of the thermal imagery. The EMAP module includes Bluetooth for direct robot-robot communications facilitating cooperative surveys, with reduced congestion on the WiFi network. Additionally, this will facilitate multi-robot research and experimentation. The Phase I effort will include benchtop validation of the proposed multi-sensor package. NK Labs excels at the design of highly-integrated electronics and has partnered with Aurora Flight Sciences for expertise in development and on-orbit integration of the popular SPHERES platform. This module concept is extensible to different modular AFF platforms, and its sensor package can be adapted to enable extravehicular environmental diagnostics. This application enhances the utility of AFFs during deep space exploration missions via more frequent monitoring of habitat environmental conditions critical to crew safety, while adding a complementary layer of redundancy to extant environmental monitoring systems.

Anticipated Benefits

The EMAP Module enables the Astrobee platform to frequently and reliably collect intravehicular environmental data in near-term NASA missions. The product concept is extensible to intravehicular and extravehicular AFF platforms envisioned for deep-space exploration missions. An EMAP-enabled AFF can work to monitor environmental conditions of crewed habitats, life support systems, agricultural experiments, and perform structural inspections of NASA spacecraft and extraterrestrial habitats.



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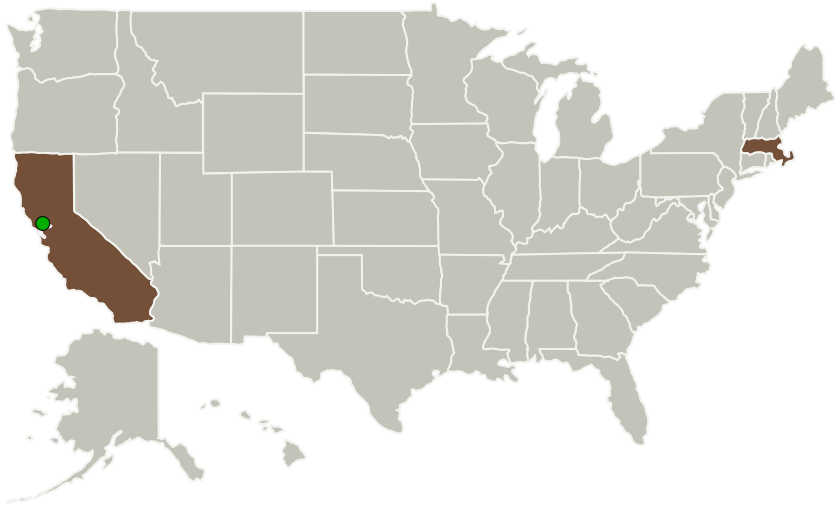
NK Labs plans to evolve the EMAP Module to meet the needs of commercial human spaceflight operations, such as environmental monitoring of commercial crewed spacecraft now in early stages of testing and evaluation. NK Labs plans to design and market an autonomous aerial survey device using the sensing, mapping and machine vision technology from this project. This drone-based platform could survey the environmental conditions in buildings, farms, factories, chemical plants and similar places.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
NK Labs, LLC	Lead Organization	Industry	Cambridge, Massachusetts
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

NK Labs, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

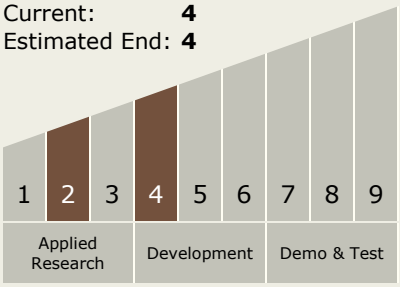
Carlos Torrez

Principal Investigator:

Rachel Chaney

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Project Transitions

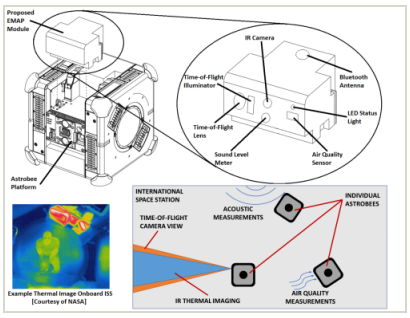
July 2018: Project Start

February 2019: Closed out

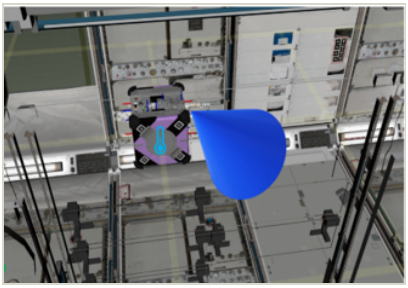
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141334)*

Images



Briefing Chart Image
Environmental Mapping Payload Module for Astrobee, Phase I *(https://techport.nasa.gov/image/134994)*



Final Summary Chart Image
Environmental Mapping Payload Module for Astrobee, Phase I *(https://techport.nasa.gov/image/125958)*

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.2 Mobility
    - TX04.2.6 Collaborative Mobility

Target Destination

Earth